



Autonomous Cooperating Symbiotic Robotic Explorers

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Lava tubes on the surface of Mars, Image Credit: ESA/FLR/FU Berlin

Humans have been exploring Mars with robotic instruments for nearly a half-century, but because of technological limits, we've only been able to investigate a small portion of the Red Planet. A team of researchers at NASA's Langley Research Center are working on robotic systems that will be able to conduct research in unexplored areas.

"One of the interests we have in Mars is looking for life" said Ken Lodding, one of the principal investigators of the project. "One possible location for life on Mars might be within lava tubes. These are areas that are better protected from radiation and have a more consistent temperature environment, but they are very difficult to get to."

The team believes it will take more than one robotic vehicle to reach them. Their work is focused on developing symbiotic robotic vehicles capable of doing so.

Symbiotic parent-child robots offer unique capabilities for these types of mission scenarios. A "parent" vehicle can provide transportation and logistical support for collaborative "child" vehicles, resulting in a system with capabilities that exceed the sum of the individual components. These compound robots enable missions that cannot otherwise be accomplished by conventional robotic architectures.

Many of the problems that currently prevent such systems from working are related to autonomous navigation. On Earth, GPS and magnetic compass are often used within robotic navigation systems, but on Mars, where neither tool is present, it becomes much more complicated.

The team has spent much of their time researching simultaneous localization and mapping (SLAM) algorithms that the robots could utilize for autonomous navigation. Under a NASA grant, they are collaborating with Professor Nicholas Roy of the Massachusetts Institute of Technology (MIT) to develop such algorithms.

The team is also looking at biologically inspired algorithms, like those of the honeybee, for answers.

"You have this little insect that can navigate up to twelve kilometers from the hive, avoid spider webs and trees, find a field of flowers to sit there and harvest nectar from. Then it integrates its path back to the hive and shares that information with others. This is very much like some of the things we are trying to accomplish and it does it with minimum computing power" said Lodding.



A robotic vehicle entering a lava tube

Once a navigation system has been created, it will be much easier to design the robotic systems that can best use it. Such robots could one day conduct research that helps scientists answer many of the questions humans have about Earth's neighboring planet.